Exercise 1

In this practical session, you are expected to create your initial model. The completed model is also provided and available so that you can compare and evaluate your own model. This activity should enhance your Arena software skills, as well as your understanding of the theory.

In this lab we will cover:

1. New modules in Arena, such as Assign, Decide, Separate (used for cloning entities), Record, and Entity Animation

2. Arena output analyser

Build your first model

The story and the model:

This system represents the final operations of the production of two different sealed electronic units, shown in Figure 3-1.   The arriving parts are cast metal cases that have already been machined to accept the electronic parts.   The first units, called Part A, are produced in an adjacent department, outside the bounds of this model, with interarrival times to our model being exponentially distributed with a mean of 5 (all times are in minutes). Upon arrival, they're transferred (instantly) to the Part A Prep area, where the mating faces of the cases are machined to ensure a good seal, and the part is then deburred and cleaned; the process time for the combined operation at the Part A Prep area follows a TRIA(1, 4, 8) distribution. The part is then transferred (instantly, again) to the sealer. T he second units, called Part B, are produced in a different building, also outside this model's bounds, where they are held until a batch of four units is available; the batch
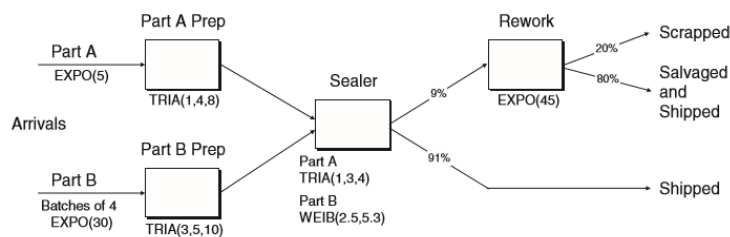

Figure 1.3 Electronic Assembly and Test System

is then sent to the final production area we are modeling. The time between the arrivals of successive batches of Part B to our model is exponential with a mean of 30 minutes. Upon arrival at the Part B Prep area, the batch is separated into the four individual units, which are processed individually from here on, and the individual parts proceed (instantly) to the Part B Prep area. The processing at the Part B Prep area has the same three steps as at the Part A Prep area, except that the process time for the combined operation follows a TRIA(3, 5, 10) distribution. The part is then sent (instantly) to the sealer. At the sealer operation, the electronic components are inserted, the case is assembled and sealed, and the sealed unit is tested. The total process time for these operations depends on the part type: TRIA(1, 3, 4) for Part A and WEIB(2.5, 5.3) for Part B (2.5 is the scale parameter ! and 5.3 is the shape parameter "). Ninety-one percent of the parts pass the inspection (that is, each part has a 0.91 probability of passing inspection) and are transferred immediately to the shipping

department; whether a part passes is independent of whether any other parts pass. The remaining parts are transferred instantly to the rework area where they are disassembled, repaired, cleaned, assembled, and retested. Eighty percent of the parts processed at the rework area are salvaged (that is, each part at this point has a 0.80 probability of being salvaged) and transferred instantly to the shipping department as reworked parts, and the rest are transferred instantly to the scrap area. The time to rework a part follows an exponential distribution with mean of 45 minutes and is independent of part type and the ultimate disposition (salvaged or scrapped). We want to collect statistics in each area on resource utilization, number in queue, time in queue, and the cycle time (or total time in system) separated out by shipped parts, salvaged parts, or scrapped parts. We will initially run the simulation for four consecutive 8-hour shifts, or 1,920 minutes.

Task:

You can now start making your model. Please open instruction file and build your model step by step .It is not necessary to submit your model in this discussion forum, but if you wish your lecturer to check anything or answer any questions, please post the model below.
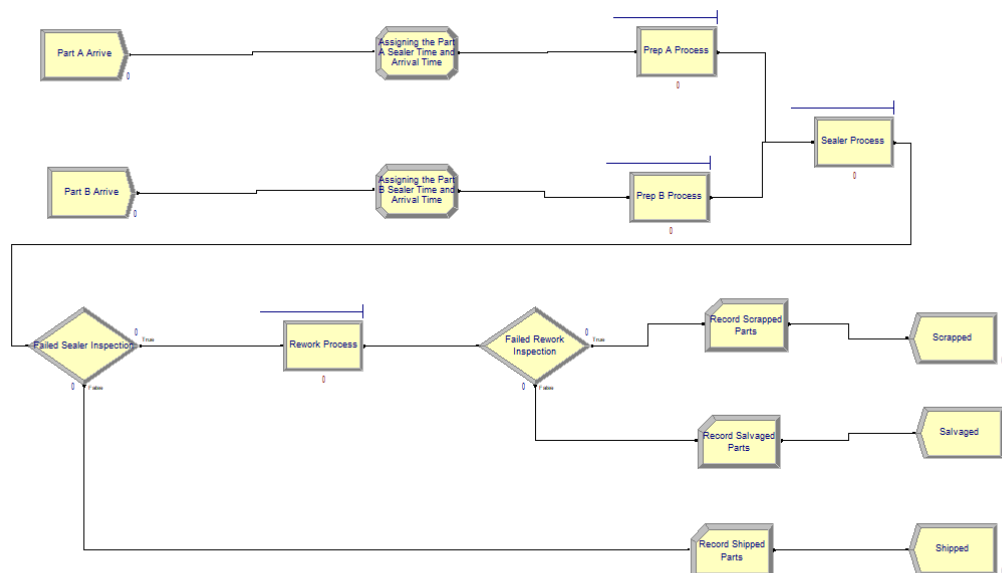
1. Before you run the model: Check Run setup
2. Run the model
3. View the results: SIMAN summary report, Category overview

Sample Summary Output

```
Project: Unnamed Project                          Run execution date : 3/28/2020
Analyst: Dr Reza Naji                             Model revision date: 3/28/2020

Replication ended at time     : 1920.0 Minutes
Base Time Units: Minutes
```

1 TALLY VARIABLES

Identifier	Average	Half Width	Minimum	Maximum	Observations
Record Scrapped Parts	365.89	(Insuf)	208.53	506.94	8
Record Salvaged Parts	1196.2	(Insuf)	467.50	1870.9	34
Record Shipped Parts	23.035	(Corr)	3.7163	67.696	424
Part B.VATime	9.5524	(Insuf)	5.0769	27.512	59
Part B.NVATime	.00000	(Insuf)	.00000	.00000	59
Part B.WaitTime	22.717	(Insuf)	.00000	323.72	59
Part B.TranTime	.00000	(Insuf)	.00000	.00000	59
Part B.OtherTime	.00000	(Insuf)	.00000	.00000	59
Part B.TotalTime	32.269	(Insuf)	5.0769	332.35	59
Part A.VATime	10.636	1.4720	3.4783	241.57	407
Part A.NVATime	.00000	.00000	.00000	.00000	407
Part A.WaitTime	41.414	(Corr)	.00000	577.23	407
Part A.TranTime	.00000	.00000	.00000	.00000	407
Part A.OtherTime	.00000	.00000	.00000	.00000	407
Part A.TotalTime	52.051	(Corr)	3.7163	591.18	407
Sealer Process.Queue.WaitingTime	.37669	.09372	.00000	4.5056	466
Prep B Process.Queue.WaitingTime	.69381	(Insuf)	.00000	8.3112	59
Prep A Process.Queue.WaitingTime	18.028	(Corr)	.00000	62.825	408
Rework Process.Queue.WaitingTime	253.21	(Insuf)	.00000	546.17	42

2 DISCRETE-CHANGE VARIABLES

Identifier	Average	Half Width	Minimum	Maximum	Final Value
Part B.WIP	.99163	(Insuf)	.00000	5.0000	.00000
Part A.WIP	11.056	(Corr)	.00000	27.000	4.0000
Prep A.NumberBusy	.91509	(Insuf)	.00000	1.0000	1.0000
Prep A.NumberScheduled	1.0000	(Insuf)	1.0000	1.0000	1.0000
Prep A.Utilization	.91509	(Insuf)	.00000	1.0000	1.0000
Prep B.NumberBusy	.18676	(Insuf)	.00000	1.0000	.00000
Prep B.NumberScheduled	1.0000	(Insuf)	1.0000	1.0000	1.0000
Prep B.Utilization	.18676	(Insuf)	.00000	1.0000	.00000
Rework.NumberBusy	.82158	(Insuf)	.00000	1.0000	.00000
Rework.NumberScheduled	1.0000	(Insuf)	1.0000	1.0000	1.0000
Rework.Utilization	.82158	(Insuf)	.00000	1.0000	.00000
Sealer.NumberBusy	.62660	.03811	.00000	1.0000	.00000
Sealer.NumberScheduled	1.0000	(Insuf)	1.0000	1.0000	1.0000
Sealer.Utilization	.62660	.03811	.00000	1.0000	.00000
Sealer Process.Queue.NumberInQueue	.09143	(Insuf)	.00000	2.0000	.00000
Prep B Process.Queue.NumberInQueue	.02132	(Insuf)	.00000	2.0000	.00000
Prep A Process.Queue.NumberInQueue	3.8457	(Corr)	.00000	15.000	3.0000
Rework Process.Queue.NumberInQueue	5.5391	(Insuf)	.00000	12.000	.00000

3 OUTPUTS

Identifier	Value
Part B.NumberIn	59.000
Part B.NumberOut	59.000
Part A.NumberIn	411.00
Part A.NumberOut	407.00
Prep A.NumberSeized	408.00
Prep A.ScheduledUtilization	.91509
Prep B.NumberSeized	59.000
Prep B.ScheduledUtilization	.18676
Rework.NumberSeized	42.000
Rework.ScheduledUtilization	.82158
Sealer.NumberSeized	466.00
Sealer.ScheduledUtilization	.62660

There are 4 types of statistics:

1. Tally Variables: These display the tallies recorded in your model. Tally statistics include entity and process costs and times.

2. Discrete Change: Time-weighted statistics 'weight' the value of the variable based on the amount of time it remained at that value. Included in this category are resource number busy, number scheduled, and utilisation, as well as number in queue statistics. These are also referred to as time persistent statistics.

3. Output: This displays statistics for the final value of a given variable of the model. Included in this category are resource costs, total process costs and times, and work in process information.

4. Counters: These are statistics for any counters identified in your model. The number of entities into and out of the system are included in this category.

Other data:

- Half width (error margin): This column, shown in the report above, is the 95% confidence interval range around the average. This is included to help you determine the reliability of the results from your replication. This column may be a value (real number), said to be 'Insufficient' or 'Correlated'.

  - Insufficient: not enough observation <320

  - Correlated: collected data for the variable is not independently distributed (invalid confidence interval). Run the simulation longer and it should correct itself.

Open file Exercise 1, available on website, and compare your final model with this sample one.